STUDIES ON THE MIGRATION OF *DANAUS PLEXIPPUS* (L.) (LEPIDOPTERA: NYMPHALIDAE) IN THE SYDNEY AREA

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Abstract

Field data on migration of *Danaus plexippus* (L.) in the Sydney area are presented. Autumn migration is predominantly coastward, with butterflies following northerly, north-easterly, easterly and south-easterly flight paths. Limited data indicate the possibility of return southerly migration following dispersal of overwintering colonies.

Introduction

In North America wanderer butterflies, *Danaus plexippus* (L.) vacate summer breeding grounds during autumn and migrate south-south westwards to overwintering areas in California and Mexico (Urquhart and Urquhart 1977, 1978). During spring, the butterflies begin a north-north easterly return migration repopulating the summer breeding areas with individuals that may have travelled up to 6000 km (Urquhart and Urquhart 1979). In 1963 the Australian Museum in Sydney with the assistance of field cooperators, began a tagging programme to investigate *D. plexippus* migration in eastern Australia. To date no large scale directional movements have been discovered, although a unidirectional flight was observed in April 1963 south of Sydney close to overwintering sites (Smithers 1965). A summer extension and winter contraction of range does occur in eastern Australia (Smithers 1977), but the importance of long distance migration is unknown. A *D. plexippus* tagging project in New Zealand gave no indication of seasonal long distance movement or migration although some long flights were recorded (Wise 1980).

Data from earlier studies strongly indicate that autumn migration to overwintering sites is a feature of *D. plexippus* biology in New South Wales (Smithers 1965, 1977; James 1982, 1983, 1984a, b, c). However, information on the extent and orientation of migration is lacking. Evidence for post-overwintering migration is scanty although a northerly movement has been reported (Common and Waterhouse 1981). This paper presents information on migratory and non-migratory movements of *D. plexippus* in New South Wales. Field observations of migration are reported together with data on dispersal of butterflies from migratory and overwintering colonies. Information on orientation of migrants and non-migrants is also presented.

Methods

Migrating *D. plexippus* observed during 1981-84 were recorded together with information on location, time, direction of flight and weather. Migrating *D. plexippus* are characterised by purposeful and sustained leisurely flight, often within a few metres of the ground (Urquhart 1960). A single direction is maintained with flight continuing over obstacles, such as trees and buildings,

rather than around them. When captured and released, migrants return to their original course. This contrasts sharply with the flight shown by non-migrants which is often of a rapid flapping nature. When confronted by obstacles, or released after capture, non-migrants invariably deviate from their original course.

During 1980-82 butterflies were tagged at migratory or over-wintering cluster sites as described elsewhere (James 1982, 1984b, c). Inclusion of a telephone number on tags enabled retrieval of information on movement after leaving cluster sites.

TABLE 1
Field observations of migrating *D. plexippus* in the Sydney area 1981-84.

Date	Location	Direction	Weather	Remarks
1981				
12.iv	Watsons Bay	E	sunny 22C, E wind	1 heading seawards
13.iv	Vineyard	NE	o'cast 25C, W wind	2, 5 min. apart
25.iv.	Freemans Rch.	NE	sunny 22C, W wind	1
20.viii	Rydalmere	S	sunny 21C, calm	1 post-cluster
21.viii	Rydalmere	S	sunny 19C, calm	1 post-cluster
22.viii	Windsor	S	sunny 17C, calm	1 post-cluster
1982				
12.iv	Freemans Rch.	NE	sunny 23C, NW wind	1
14.iv	Cobbity	NE	sunny 26C, calm	1
24.iv	Luddenham	NE	sunny 28C, calm	1
26.iv	Campbelltown	NE	sunny 20C, calm	6, 2 min. apart
26.iv	Bulli	NE	sunny 22C, E wind	1
26.iv	N Wollongong	NE	sunny 22C, E wind	2, 5 min. apart
26.iv	Currans Hill	NE	sunny 23C, SW wind	2, 5 min. apart
1983				
8.v	Glossodia	N	sunny 24C, NW wind	1
1984				
29.ii	Regentville	NE	sunny 22C, S wind	1
1.iii	Faulconbridge	N	sunny 18C, S wind	1
6.iii	Parramatta	N	sunny 24C, NE wind	1
6.iii	Toongabbie	SE	sunny 24C, NE wind	1
7.iii	Emu Plains	E	sunny 24C, NE wind	1
14.iii	Blacktown	N	sunny 21C, W wind	1
14.iii	Blacktown		sunny 21C, W wind	1
15.iii	Ryde	N	sunny 24C, SW wind	1
21.iii	Picton	N	o'cast 20C, S wind	2, 5 min. apart
23.iii	St. Marys	NE	o'cast 23C, SE wind	2, 5 min. apart
25.iii	Castle Hill	NE	o'cast 20C, NE wind	1
6.iv	Faulconbridge	E	sunny 17C, NE wind	1
7.iv	Camden	NE	sunny 24C, calm	6, 10 min. apart
7.iv	Cobbity	N	o'cast 21C, calm	1
21.iv	Merrylands	E	sunny 19C, NW wind	1
27.iv	Rydalmere	E	sunny 18C, W wind	1
4.v	Toongabbie	E	o'cast 18C, calm	1

TABLE 2
Data on movement of *D. plexippus* after leaving cluster sites

Tagging date	Cluster	Recapture location and date	Direction and distance from cluster	Remarks
12.iv.81	Picton	The Oaks 20.iv.81	10 km N	Autumn northerly migration. Picton cluster 1981 & Wallacia/ Camden clusters 1982 were migratory during April/May (James 1982, 1984a, b)
12.iv.81	Picton	Werombi 2.v.81	15 km N	
2.v.82	Camden	Menangle Park 26.vi.82	7 km N	
23.v.82	Camden	Camden 9.vi.82	1 km N	
25.v.82	Wallacia	Wallacia 13.vi.82	3.5 km N	
25.iv.82	Camden	Picton 21.vii.82	10 km SW	Mid-winter post-cluster "return migration"
9.v.82	Camden	Yerrinbool 9.vii.82	35 km SSW	
6.vi.82	Camden	Tahmoor 17.vii.82	15 km SSW	

An earlier study reported data on the extent of movement shown by mass-released reproductive (non-migrant) and non-reproductive (migrant) *D. plexippus* (James 1983). Data on flight orientation on butterflies in this study are presented here.

Results

Field observation of migrating D. plexippus

Observations on migrating *D. plexippus* are summarised in Table 1. Twenty eight of the 31 observations occurred in autumn and were of butterflies flying in an easterly, northerly, or most commonly, north-easterly direction. The remaining three observations of butterflies flying southward, occurred in late winter and were possibly post-cluster movements. Most observations occurred during warm, sunny weather with little or no wind. Butterflies were often observed flying into light headwinds.

Movement of D. plexippus *after leaving cluster sites*

Information obtained on the movement of *D. plexippus* after leaving cluster sites is shown in Table 2. Only eight of more than 3,500 butterflies tagged in clusters during 1980-82 were subsequently recaptured away from the sites. Three tagged in the 1982 Camden overwintering colony were recaptured 10-35 km south west of the site, after the colony had broken up. Five butterflies tagged in autumn migratory colonies were recaptured 1-15 km northward before the dispersal of overwintering clusters.

Flight orientation of migrant and non-migrant D. plexippus

Data on flight orientation of 55 non-migrants and 103 migrants recaptured after autumn release and presented as percentages of butterflies recovered in the four major compass sectors are shown in Fig. 1. The few butterflies that flew true north, south, east or west were equally divided between adjacent sectors. Non-migrants radiated relatively evenly from a central point while migrants showed a clear preference for easterly flight orientation.

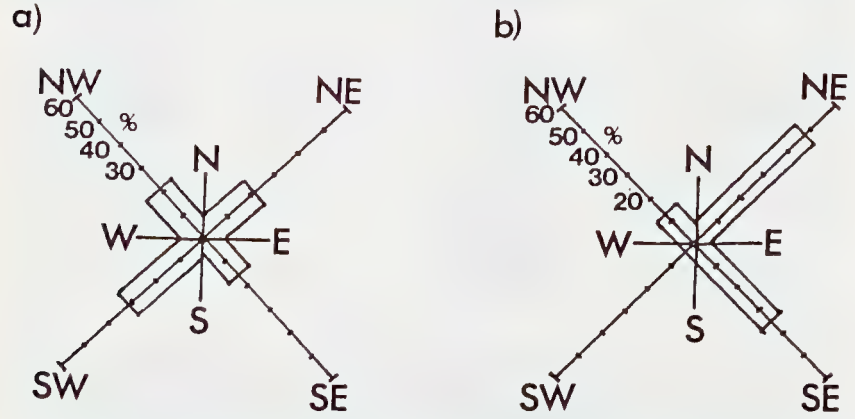

Fig. 1. Orientation of migrant (a) and non-migrant (b) *D. plexippus*. Data represents percentages of recaptures made in north-east, north-west, south-east and south-west sectors after autumn mass releases.

Discussion

The data presented here, although limited, are consistent in indicating that a coastward migration of non-reproductive *D. plexippus* occurs during autumn in New South Wales as suggested by earlier studies (Smithers 1965, 1977; James 1982, 1983). Observations suggest that a northerly or north-easterly direction is most often taken, while the orientation data indicate major north-east and south-east movement. Some evidence for a return south-westward migration, following the break-up of overwintering colonies, was obtained from field observations and the recapture of butterflies tagged in winter clusters.

The relatively small populations of *D. plexippus* in New South Wales makes autumn migrants less noticeable than they are in North America (Urquhart 1960). However, the large population in autumn 1982 resulted in an abundance of migrants in south-western areas of the Sydney basin, with many found dead on the roads. Most migrants flew alone, although on a number of occasions some were following the same route, a few minutes apart. The majority of migrants followed a north-easterly course. The data on flight orientation of autumn released non-reproductive *D. plexippus* also

indicate a substantial coastward movement. North easterly movement was also shown by nine migrants recaptured at distances of 10-380 km after release near Canberra (James 1983). In contrast reproductive butterflies show no preference in flight orientation.

Only three of more than 3,500 butterflies tagged at cluster sites were recovered after overwintering colonies had dispersed. These three showed south-westerly movement of 10-35 km, which is considered to have represented a return migration. If there is a strong south to south-west post cluster movement, it would result in butterflies entering relatively sparsely populated tableland areas thus greatly limiting the probability of recapture. The direct observations of three butterflies migrating southwards in August 1981 provides further evidence of a return southerly movement.

These results, together with earlier data (James 1982, 1984b) demonstrate that a regular north to north-east migration of *D. plexippus* occurs during autumn in New South Wales. This results in the withdrawal of butterflies from southern and western areas of New South Wales, and their accumulation in milder coastal areas where overwintering colonies are formed. From limited data, it is postulated that some return southerly movement occurs in mid-late winter when clusters disperse.

References

Common, I. F. B. and Waterhouse, D. F., 1981. *Butterflies of Australia.* Revised edition. Angus and Robertson, Sydney. Pp. i-xiv, 1-682, illustr.

James, D. G., 1982. A transient non-breeding population of *Danaus plexippus* (L.) (Lepidoptera: Nymphalidae) near Picton, New South Wales. *Aust. ent. Mag.* 8: 96-99.

James, D. G., 1983. Induction of reproductive dormancy in Australian monarch butterflies, *Danaus plexippus. Aust. J. Zool.* 31: 497-504.

James, D. G., 1984a. Phenology of weight, moisture and energy reserves of Australian monarch butterflies, *Danaus plexippus. Ecol. Ent.* 9:

James, D. G., 1984b. Migration and clustering phenology of *Danaus plexippus* (L.) (Lepidoptera: Nymphalidae) in Australia. *J. Aust. ent. Soc.* 23: 199-204.

James, D. G., 1984c. Population and general biology of non-reproductive colonies of the monarch butterfly, *Danaus plexippus* (L.) (Lepidoptera: Danaidae) in New South Wales. *Aust. J. Zool.* 32: 663-670.

Smithers, C. N., 1965. A note on overwintering in *Danaus plexippus* (L.) (Lepidoptera: Nymphalidae) in Australia. *Aust. Zool.* 13: 135-136.

Smithers, C. N., 1977. Seasonal distribution and breeding status of *Danaus plexippus* (L) (Lepidoptera: Nymphalidae) in Australia. *J. Aust. ent. Soc.* 16: 175-184.

Urquhart, F. A. and Urquhart, N. R., 1977. Overwintering areas and migratory routes of the monarch butterfly (*Danaus p. plexippus*, Lepidoptera: Danaidae) in North America, with special reference to the western population. *Can. Ent.* 109: 1583-1589.

Urquhart, F. A. and Urquhart, N. R., 1978. Autumnal migration routes of the eastern population of the monarch butterfly (*Danaus p. plexippus* L., Danaidae: Lepidoptera) in North America to the overwintering site in the Neovolcanic Plateau of Mexico. *Can. J. Zool.* 56: 1754-1764.

Urquhart, F. A. and Urquhart, N. R., 1979. Vernal migration of the monarch butterfly (*Danaus p. plexippus*, Lepidoptera: Danaidae) in North America from the overwintering site in the Neovolcanic Plateau of Mexico. *Can. Ent.* 111: 15-18.